



CASSIDY

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THE FIRST STELLAR SAṂSKĀRA

By Sum Bunny

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CASSIDY: THE FIRST STELLAR SAMSKĀRA

A Systems-Level Framework for Post-Engine Stellar Dynamics

By Sum Bunny

(Author's Note: Dedicated to Bob Weir (1947–2026). "Let your life proceed by its own design.")

Abstract

We introduce the classification **Post-Engine Coherent Remnant (PECR)**—phenomenologically termed **Stellar Samskāra** (Type-S)—to describe stellar remnant systems in which large-scale ordered dynamics persist despite the absence of a contemporary energy engine capable of sustaining them. A Samskāra is defined by a dynamical coherence time (τ_{dyn}) significantly exceeding the thermal or rotational relaxation time (τ_{rel}) of the central compact object. Using the anomalous white dwarf system **RX J0528+2838** ("Cassidy") as a prototype, we analyze the energy budget deficit required to sustain its inexplicable 3,800 AU bow shock. We find that the kinetic energy of the structure exceeds the integrated magnetic and rotational reservoirs by orders of magnitude. We propose **Metric Memory**—specifically, a long-lived scalar field configuration sourced by the release of gravitational binding energy during collapse—as a candidate mechanism. We outline a falsification matrix utilizing a proposed intensity interferometry protocol ("**Fossil-LiDAR**") to distinguish these "karmic traces" of spacetime from standard magnetohydrodynamic artifacts.

I. The Object That Would Not Behave

There is a hole in our catalog of dead stars.

We understand White Dwarfs. They are simple corpses: electron-degenerate matter cooling over billions of years. They do not have fusion engines. They do not have accretion disks (unless they are stealing from a neighbor). They are physically quiet.

RX J0528+2838 refuses to be quiet.

Located 730 light-years away, this isolated magnetic white dwarf sits inside a massive, structured bow shock spanning roughly 3,800 AU. The shock suggests a violent outflow or a high-velocity plow through the interstellar medium (ISM). Yet, the star shows no signs of accretion, no binary companion to drive a wind, and a magnetic field too weak to sustain such a structure for the estimated age of the shock ($>1,000$ years).

The star is off. The engine is cold. But the structure is hot.

Recent observations [3] confirm this anomaly: a persistent bow shock that cannot be explained by standard wind or outflow mechanisms. Astronomers call it a puzzle. We call it **Samskāra-1** ("Cassidy"). It is the first identified member of a new class of object: a system where the effect has outlived the cause.

II. The Energy Bookkeeping Problem

Before invoking new physics, we must exhaust the old. The central problem of RX J0528+2838 is not morphology, but thermodynamics. We must compare the energy required to create the structure (E_{struct}) against the available reservoirs (E_{res}).

1. The Structure's Cost

Assuming a shock radius $R \approx 3800$ AU and a conservative ISM density $n \sim 1 \text{ cm}^{-3}$, the mass of the swept-up shell is substantial. If the expansion velocity is merely typical of white dwarf winds ($v \sim 50 \text{ km/s}$), the kinetic energy is:

$$E_k \approx \frac{1}{2} M_{\text{shell}} v^2 \sim 10^{42} \text{ erg}$$

2. The Star's Wallet

- **Magnetic Reservoir:** For a dipole field $B \sim 10^6 \text{ G}$ and radius $R_* \sim 10^9 \text{ cm}$, the total external field energy is $E_B \approx \frac{1}{6} B^2 R_*^3 \sim 10^{35} \text{ erg}$.
 - *Deficit:* $E_k \gg E_B$. The magnetic tank is empty by seven orders of magnitude.
- **Rotational Reservoir:** The star is a slow rotator. There is insufficient spin-down power to drive a pulsar-like wind.

3. Standard Explanations (and Failure Modes)

- **Fossil Fields:** A hidden 10^9 G field would decay via ohmic dissipation too quickly to sustain a structure this old.
- **ISM Density Spike:** The morphology indicates outflow/expansion, not a simple "plough" wake trailing the velocity vector.
- **Hidden Companion:** Deep IR surveys rule out brown dwarfs down to Jupiter mass.

We are left with a deficit. The energy required to maintain the structure exceeds the integrated output of known reservoirs. The energy must be sourced elsewhere.

III. Definition: The Stellar Samskāra

We adopt the formal designation **Post-Engine Coherent Remnant (PECR)**, and the phenomenological term **Sam̐skāra** (Sanskrit for impression; trace; karmic memory).

Definition: A **Stellar Sam̐skāra** is a remnant system where the local vacuum retains a dynamical "impression" of a past high-energy event, sustaining ordered structure long after the event has ceased.

It is the astrophysical equivalent of **Hysteresis**.

- In ferromagnetism, a material stays magnetized after the external field is removed.
- In geology, rock retains stress patterns after the tectonic force is gone.
- In a Sam̐skāra, **spacetime retains geometry** after the mass-energy event has passed.

IV. The Hypothesis: Metric Memory

Where is the missing energy stored? We propose it is stored in a **long-lived scalar field configuration** that sources a deformation of the metric.

Drawing on **Scalar-Gauss-Bonnet** gravity models [1], we posit that the violent collapse of the progenitor star did more than crush matter. It "scalarized" the local vacuum.

The Source:

The energy budget is closed by the release of gravitational binding energy ($\Delta E \approx GM^2/R$ during core collapse). A fraction of this energy, rather than radiating away as photons or neutrinos, is coupled into the scalar sector via the curvature spike ($S \sim \beta\phi G$).

The Memory:

Now, the star is dead. The curvature has dropped. But the scalar field has a non-zero relaxation time ($\tau \sim 1/m_\phi$). It does not snap back to zero instantly.

Parameter Space:

To explain a persistence of millennia ($\tau \gtrsim 10^3$ yr), the scalar mass must be ultralight:

$$m_\phi \lesssim 10^{-22} \text{ eV}$$

This corresponds to coherence lengths of order parsecs or larger. This places the mechanism in a narrow window bounded by binary pulsar constraints and fifth-force experiments [2]. We are not observing the star driving a wind; we are observing the **vacuum relaxing** around it. Cassidy is not powering the structure. Cassidy is the tombstone marking the center of the relaxation event.

V. Why "Cassidy"? (Saṃskāra-1)

We designate RX J0528+2838 as **Saṃskāra-1** ("Cassidy") because the lyrics of the song perfectly illustrate the physical mechanism of a PECR.

The song *Cassidy* speaks to the continuity between a departure and a new beginning. It describes a flight that continues without the pilot.

"Flight of the seabirds, scattered like lost words / Wheel to the storm and fly."

This is the observable morphology: the expanding shell scattered outward, maintaining structure (the wheel) despite being "lost" from the source.

"Faring thee well now / Let your life proceed by its own design."

This is the definition of a Saṃskāra. The star has said "fare well" —the engine has stopped. Yet the metric structure "proceeds by its own design." It has decoupled from the thermodynamics of the star and is now driven by the hysteresis of the vacuum.

VI. Testing the Saṃskāra

This is not a metaphysical claim. It is a testable hypothesis distinct from standard plasma physics.

The Falsification Matrix:

Observable	Standard Model (Magnetism)	Saṃskāra Model (Metric Memory)
Alignment	Dipole or Velocity Vector	Inferred Progenitor Symmetries
Radio Static	Gaussian Thermal Noise	Vacuum Texture (Non-Gaussian)
Optical Signal	Poissonian Statistics	Correlation Excess ($g^2 > 1$)

The Experiment:

To falsify this, we must look beyond standard imaging. We propose a new observational protocol: Fossil-LiDAR (FLiDAR).

If the shock structure is held up by metric rigidity rather than gas pressure, the reflected light should show specific **intensity correlation anomalies**. By utilizing intensity interferometry (the Hanbury Brown-Twiss effect), we can filter out atmospheric turbulence and look for deviations from Kolmogorov statistics that persist across large baselines. If Cassidy is a true Saṃskāra, the vacuum texture itself will leave a statistical fingerprint on the light scattering off the shock.

VII. Failure Modes

We must explicitly state what would kill this hypothesis. The Saṃskāra classification for RX J0528+2838 is falsified if:

1. **Hidden Engine:** A faint companion is discovered deep in the noise floor.
2. **Field Revision:** New polarimetry reveals the magnetic field is orders of magnitude stronger than current estimates ($>10^8$ G).
3. **Null Static:** Radio intensity interferometry reveals purely Poissonian/Gaussian statistics consistent with simple thermal shock heating.

VIII. Conclusion

The universe may be harder to erase than we thought.

Standard cosmology assumes that when a star dies, its influence ends at the speed of light. Gravity relaxes instantly; the metric forgets. The existence of **Stellar Saṃskāras** suggests otherwise. It suggests that violent events leave scars—deep, structural impressions in the vacuum that take eons to fade.

We have been looking for the engine inside the star, but the energy was never there. It was written into the space around it. Like the song says, the words are scattered, but they are still flying.

References

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This was written through a collaboration between a human author and AI systems acting as analytical tools. The machines provided structure; the human provided judgment. Nothing appears here that the author did not personally create, refine, choose, and claim.

**HEY JOSIANE,
CAN I MAKE YOU SOME OATMEAL?
SUM BUNNY LOVES YOU!!!**



FREE FLASH